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TRANSPORTATION STUDIES AT PRIEST RAPIDS DAM, 1985

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Annual Report of Research
Financed by
Public Utility District No. 2
of Grant County
(Contract 430-228)

and

Coastal Zone and Estuarine Studies Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
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2725 Montlake Boulevard East
Seattle, Washington 98112

November 1985

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INTRODUCTION

The National Marine Fisheries Service (NMFS) entered into an agreement with the Grant County Public Utility District (PUD) in 1984 to participate in research aimed at determining the benefit of transporting juvenile smolting chinook and sockeye salmon collected at Priest Rapids Dam to a release site below Bonneville Dam. This year (1985) was the second year of a 3-year study for marking juvenile chinook and sockeye salmon at Priest Rapids Dam, and is one of three related studies conducted under the guidelines established by the Mid-Columbia River Studies Committee.

Research conducted by the NMFS on the Snake River in previous years indicates that the transportation of juvenile salmonids from upriver collector dams to a release site below Bonneville Dam can substantially increase the survival of smolts and subsequent returning adults compared with smolts not transported (Ebel 1980; Park 1980; Park 1985). If proven beneficial at Priest Rapids Dam, transportation of smolts can provide managers with an option for protecting valuable stocks of salmonids from the mid-Columbia region.

In 1985, the NMFS had the following objectives: (1) provide sorting of juvenile salmonids collected at Priest Rapids and Wanapum Dams by personnel from the Grant County Public Utility District (PUD); (2) provide marking of juvenile chinook and sockeye salmon for the transport study; (3) determine the relative stress induced in spring chinook salmon by the fish handling/marking and transport, as measured by seawater challenge; and (4) monitor the return of adults in fisheries and at Columbia River trapping facilities from juveniles that were tagged at Priest Rapids Dam in 1984.

METHODS

Fish Collection, Handling, and Marking

The fish handling and marking facility placed at Priest Rapids Dam by the NMFS was operational by 20 April 1985 and included two mobile fish marking units and a mobile sorting unit. These facilities (smolt collection gear and methods) and fish transport apparatus were described by Dell et al. 1985.

Grant County PUD personnel collected the fish to be used for the study from the turbine intake gatewells at Priest Rapids Dam as in 1984, and from Wanapum Dam. All fish were transported to the sorting and marking complex at Priest Rapids Dam. The fish were dipped from the gatewells at Wanapum Dam with a specially designed "butterfly" type dip net which funneled fish into a sanctuary bag on the bottom of the net. After a gatewell was dipped, the sanctuary bag on the dip net was positioned over a 285-gallon capacity circular tank with the water lowered to the 225-gallon level; a trap door was released and fish and water entered the tank through a chute immediately bringing the water level to the full 285-gallon capacity. If another gatewell was dipped and the fish were to be released into the same tank, the water level was reduced to the 225-gallon level and the process was repeated. Fish dipped from the gatewells were distributed to six tanks--two tanks mounted on each of three flatbed trailers. Each tank was equipped with a recirculation and oxygenation system. During the trip from Wanapum Dam to Priest Rapids Dam, the recirculation and oxygen systems were used. Upon arrival at Priest Rapids Dam, the life support systems were shut down, and the tanks were attached to freshwater lines. The fish from Wanapum Dam were held while the fish collected from Priest Rapids Dam were being marked. Upon completion of marking fish from Priest Rapids Dam, the trailers containing fish from Wanapum Dam were moved to the sorting unit. The water was lowered in one of the tanks

to the 225-gallon level, and all the fish in the tank were anesthetized with a 37.5 ppm concentration of MS-222. They were then dipped with a sanctuary dip net to the splash pan leading to the sorting trough.

The fish in the sorting unit were identified by species and examined for prior marks. Brands were recorded on fish collected from Priest Rapids Dam for the Water Budget Center (WBC). All marked fish together with all coho salmon and steelhead were passed via a freshwater line to the circular tank where they were held until nighttime and then released into the Columbia River. Chinook and sockeye salmon to be marked were passed via anesthetic water lines to the tagging units after receiving an adipose fin clip at the sorting station. All smolt-sized fish were marked unless they showed obvious signs of injury or trauma. One marking unit was set up for marking transported fish, the other for marking controls for release into the river below the dam. To assure random and equal distribution of species and fish numbers between the two marking units, personnel clipping the adipose fins alternately distributed the fish to each marking unit. In each marking unit, fish were freeze branded with a tool cooled by liquid nitrogen, tagged with a magnetic coded wire tag (CWT), and passed through a detection system and accepted or rejected to ensure the presence of a magnetized tag. Fish markers were rotated periodically between the sorting and marking units to ensure equal marking treatment of transport and control marked groups. Following marking, the fish passed through a pipe via fresh water to either a fish holding tank for release into the river at night (control) or to a transport tank for transportation by truck to the release site below Bonneville Dam. During fish marking operations, fish were periodically taken from the marking lines and held for a 5-day observation period to determine delayed mortality, tag retention, and brand legibility.

Wire tag codes and brands were changed weekly to obtain contribution data from the various segments of the smolt outmigration. Different wire codes and brands were used to identify fish collected from Wanapum and Priest Rapids Dams as well as transport and control releases. Different wire codes were also used on sockeye and chinook salmon, but the same brand was used on both species.

Seawater Challenge Stress Studies

Three separate seawater challenge test series were conducted on 8, 11, and 15 May to provide a profile of the relative stress levels of chinook salmon smolts during the handling/marking and transport operations. The tests were conducted in mobile laboratories located at Priest Rapids and Bonneville Dams and used static seawater challenge bioassay techniques described by Park et al. (1983). Although the tests targeted chinook salmon, we also recorded information on sockeye salmon which were inadvertently sampled together with the target species.

On 5 May 1985, we conducted a preliminary bioassay to determine the appropriate salinity level for use during the study. We desired a salinity which would provide a mortality level of 10 to 20% in least stressed fish. To determine this level, we sampled three groups of fish from the transfer container (unanesthetized) as it arrived at the marking facility and challenged them to 32, 34, and 36 ppt artificial seawater for 24 h. This test indicated that 32 ppt would provide the desired mortality level, and it was used as the initial salinity level for the first test series conducted on 8 May. However, mortalities in this test were lower than expected (< 10% in all groups). Brand recoveries indicated that large numbers of smolts from Winthrop Hatchery arrived at the dam between the time we sampled for the preliminary test series on 5 May and the first test on 8 May. Apparently,

these fish had a higher tolerance to seawater than the fish that comprised the population during the preliminary test series. To compensate for this increased tolerance, we increased the salinity to 34 ppt during the final two tests (11 and 15 May).

During the first test series, each test group consisted of three replicates of approximately 20 to 30 fish each; during the last two test series, each test group consisted of four replicates of approximately 20 to 30 fish each. Sample points for the tests were as follows:

1. Pre-Mark Group.--These fish were sampled from the transfer container as it arrived at the marking facility. This group represented the stress level of smolts prior to handling/marking and transport.

2. Pre-Transport Group.--This group was sampled from the transport tank just prior to transport. The difference in the seawater mortality level between this group and the previous group would isolate stress associated with the handling/marking process.

3. Post-Transport Group. This group was sampled from the transport tank immediately after arrival at Bonneville Dam. The difference in the seawater mortality level measured between this group and the previous group would isolate stress associated with transportation.

At the termination of each 24-h seawater challenge test series, live and dead fish were enumerated. Data were also obtained on individual lengths and descaling (Appendix Table 1). To test for statistical differences among the test groups, contingency tables were formed using these counts. The G-statistic as described by Sokal and Rohlf (1981) was used to test for significance at ($P < 0.05$, $df = n$).

Collection of Adults from Transportation Tests in 1984-85

The NMFS is receiving CWT return data through the regional coast wide sampling effort administered by the Pacific Marine Fisheries Commission. These data are primarily recovered from the various ocean fishing areas and the Columbia River commercial fisheries--including the tribal fisheries in Zone 6.

In 1985, the NMFS operated trapping facilities at Bonneville and McNary Dams during July and August specifically to trap sockeye salmon that had been tagged as smolts for transportation evaluation at Priest Rapids Dam in 1984.

Returns from hatcheries and spawning grounds will be reported to NMFS as these data become available. Data from all sources may be used for statistical analysis when returns are complete.

RESULTS AND DISCUSSION

Fish Handling and Marking

From fish collected at Priest Rapids Dam during the marking season (20 April to 5 June), 50,490 spring chinook salmon and 55,406 sockeye salmon were marked with CWT, freeze brands, and adipose fin clips and transported by truck to a release site below Bonneville Dam (Table 1). In addition, 26,287 spring chinook salmon and 8,602 sockeye salmon collected from Wanapum Dam (1 May to 5 June) were marked and likewise transported (Table 2). An additional 49,700 spring chinook salmon and 55,432 sockeye salmon collected from Priest Rapids Dam (Table 1) and 25,553 spring chinook salmon and 8,599 sockeye salmon collected from Wanapum Dam (Table 2) were marked and released as controls below Priest Rapids Dam.

A total of 539 spring chinook salmon and 549 sockeye salmon were marked and held during five 5-day holding periods throughout the marking season

Table 1.--Summary of brands and wire codes used to identify juvenile spring chinook and sockeye salmon that were collected and marked at Priest Rapids Dam and transported by truck to below Bonneville Dam or released as controls below Priest Rapids Dam, 1985.

Marking period	Brand position symbol, & orientation[a/]	Wire code		Number marked
Truck Transport				
Chinook salmon				
20-28 Apr	RA-1H, 1	23-17-46		7,285
28 Apr - 04 May	RA-1J, 1	23-17-10		8,388
05-12 May	RA-1K, 1	23-17-12		14,384
13-19 May	RA-1H, 3	23-17-14		10,688
20-26 May	RA-1J, 3	23-17-48		6,405
27 May - 05 Jun	RA-1K, 3	23-17-56		3,340
			Total	50,490
Sockeye salmon				
20-28 Apr	RA-1H, 1	23-17-16		10,232
28 Apr - 04 May	RA-1J, 1	23-17-50		8,146
05-12 May	RA-1K, 1	23-17-52		8,171
13-19 May	RA-1H, 3	23-17-54		6,506
20-26 May	RA-1J, 3	23-17-26		10,259
27 May - 04 Jun	RA-1K, 3	23-17-57		12,092
			Total	55,406
Control				
Chinook salmon				
20-28 Apr	LA-1L, 1	23-17-53		6,603
28 Apr - 04 May	LA-1N, 1	23-17-11		8,201
05-12 May	LA-1S, 1	23-17-13		14,431
13-19 May	LA-1L, 3	23-17-15		10,569
20-26 May	LA-1N, 3	23-17-55		6,779
27 May - 05 Jun	LA-1S, 3	23-17-58		3,117
			Total	49,700

Table 1.--Continued.

Marking period	Brand position symbol, & orientation[a/]	Wire code	Number marked
Sockeye salmon			
20-28 Apr	LA-1L, 1	23-17-17	9,614
28 Apr -04 May	LA-1N, 1	23-17-47	8,189
05-12 May	LA-1S, 1	23-17-49	8,171
13-19 May	LA-1L, 3	23-17-51	6,451
20-26 May	LA-1N, 3	23-17-19	10,403
27 May - 04 Jun	LA-1S, 3	23-17-59	12,604
		Total	55,432

[a/] Brand positions abreviations are: RA = right anterior, LA = left anterior. Brand symbol is self explanatory. Brand orientation--refers to rotation of the brand around its centerpoint, e.g., 1 corresponds to the normal orientation, A; 2 to ⋗ ; 3 to ∀ ; 4 to ≺ .

Table 2.--Summary of brands and wire codes used to identify juvenile spring chinook and sockeye salmon that were collected at Wanapum Dam, marked at Priest Rapids Dam, and transported by truck to below Bonneville Dam or released as controls below Priest Rapids Dam, 1985.

Marking period	Brand position symbol, & orientation[a/]	Wire code		Number marked
Truck transport				
Chinook salmon				
01-04 May	RA-1Z, 1	23-17-28		6,964
05-13 May	RA-1Y, 1	23-17-30		7,543
15-19 May	RA-1X, 1	23-17-40		5,827
20-26 May	RA-1Z, 3	23-17-22		4,266
27 May - 05 Jun	RA-1Y, 3	23-17-44		1,687
			Total	26,287
Sockeye salmon				
01-4 May	RA-1Z, 1	23-16-62		2,127
05-13 May	RA-1Y, 1	23-17-18		947
15-19 May	RA-1X, 1	23-17-20		1,049
20-26 May	RA-1Z, 3	23-17,42		2,149
27 May - 03 Jun	RA-1Y, 3	23-17-24		2,330
			Total	8,602
Control				
Chinook salmon				
01-04 May	LA-2C, 1	23-17-25		7,067
05-13 May	LA-2J, 1	23-17-27		7,404
15-19 May	LA-14, 1	23-17-41		5,398
20-26 May	LA-2C, 3	23-17-43		4,005
27 May - 05 Jun	LA-2J, 3	23-17-45		1,679
			Total	25,553
Sockeye salmon				
01-04 May	LA-2C, 1	23-16-61		2,299
05-13 May	LA-2J, 1	23-16-63		1,069
15-19 May	LA-14, 1	23-17-01		835
20-26 May	LA-2C, 3	23-17-21		2,014
27 May - 03 Jun	LA-2J, 3	23-17-23		2,382
			Total	8,599

[a/] Brand positions abreviations are: RA = right anterior, LA = left anterior. Brand symbol is self explanatory. Brand orientation--refers to rotation of the brand around its centerpoint, e.g., 1 corresponds to the normal orientation, A; 2 to ≻; 3 to ∀; 4 to ≺.

(Table 3). Delayed mortality was 0.9% for chinook salmon and 1.1% for sockeye salmon. Tag loss averaged 2.2% for chinook salmon and 3.3% for sockeye salmon. Brand placement, retention, and legibility were judged good during the season for both species, with only 5.1 and 5.9% poor brands on chinook and sockeye salmon, respectively.

A combined total for both dams of 255 chinook salmon "0s", 18,326 chinook "1s", 15,734 sockeye salmon, 53,127 steelhead, and 1,622 coho salmon were sorted directly to a holding tank and subsequently released into the river during the marking period. A grand total of 369,133 fish were handled at the sorting and marking complex in 1985 (Table 4).

Seawater Challenge Studies

Results of the seawater challenge stress tests conducted on spring chinook salmon are presented in Figure 1 and Appendix Table 1. Data from the first test series conducted at 32 ppt indicated no significant increase in stress occurred during handling/marking or transport. Likewise, data from the second and third tests conducted at 34 ppt again indicated no significant increase in stress occurred during the entire procedure. For similar but admittedly limited studies conducted in 1984, Dell et al (1985) reported no increase in stress during handling/marking but a possible increase during transport. This year's results strongly support the former and reject the latter findings. It is apparent from both years' results that the pre-anesthesia concept (anesthetizing fish prior to handling) is a viable method for minimizing stress during fish handling/marking operations.

As mentioned previously, some sockeye salmon smolts were inadvertently included in this study which was specifically targeted for spring chinook salmon. The information for this species is very weak and will not be presented here. However, the information, together with other field

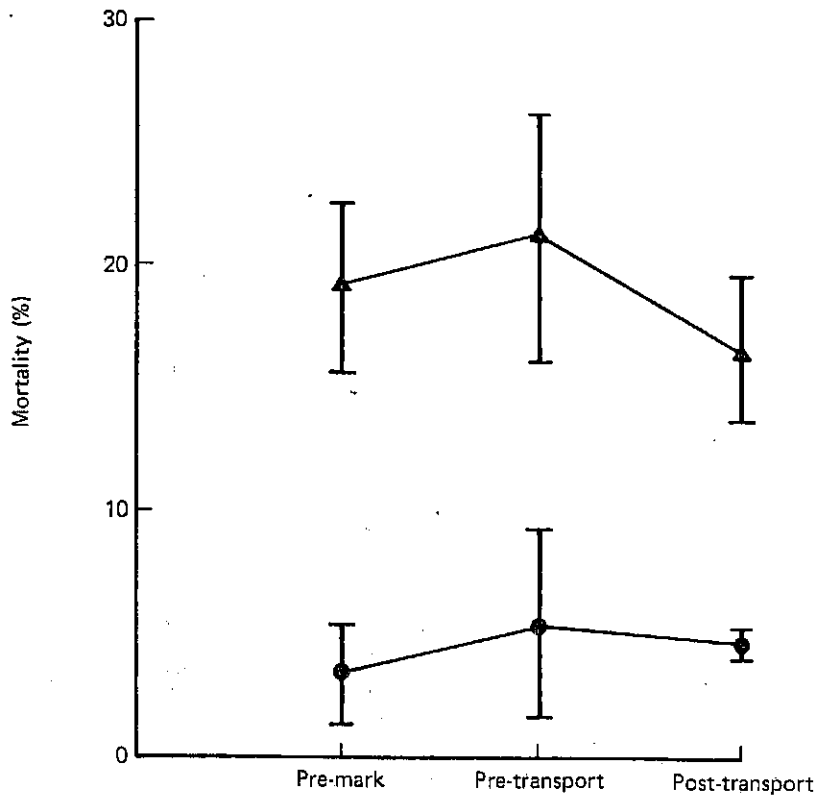

Figure 1.--Seawater challenge tests for relative stress of spring chinook salmon smolts sampled prior to marking, prior to transport, and after transport at Priest Rapids Dam, 1985 [vertical bars indicate S.E.; ● = one test series at 32 ppt on 8 May, ▲ = two test series at 34 ppt (11 and 15 May)].

Table 3.--Summary of survival, mortality, tag loss, and brand placment and condition after 5-day holding of marked juvenile spring chinook and sockeye salmon at Priest Rapids Dam, 1985.

Holding period	Number alive	Number dead	Number with lost tags	Brand condition & placement		
				Number good	Number fair	Number poor
Chinook						
28 Apr - 03 May	119	0	6	112	5	2
04-09 May	111	0	2	94	13	4
12-17 May	105	0	1	97	7	1
19-24 May	94	2	2	80	11	3
25-30 May	105	3	1	49	39	17
Totals	534	5	12	432	75	27
Sockeye						
28 Apr - 03 May	109	0	4	97	5	7
04-09 May	119	2	1	96	10	13
12-17 May	112	0	5	97	7	8
19-24 May	100	0	6	87	11	2
25-30 May	103	4	2	92	9	2
Totals	543	6	18	469	42	32

Table 4.--Summary of total numbers and species composition of fish handled at the Priest Rapids sorting and marking complex, 1985 (20 Apr-05 Jun).

Species	Priest Rapids		Wanapum		Total	
	No.	%	No.	%	No.	%
Chinook "0"	239	0.1	16	0.0	255	0.1
Chinook "1"	111,602	41.3	58,754	59.5	170,356	46.2
Sockeye	123,365	45.6	20,408	20.7	143,773	38.9
Steelhead	34,270	12.7	18,857	19.1	53,127	14.4
Coho	905	0.3	717	0.7	1,622	0.4
Totals	270,381		98,752		369,133	

observations, suggest that the handling/marking process may elicit a stress response from this species. We have observed that most sockeye salmon smolts readily swim about in the anesthetic troughs during the handling/marking process indicating a higher tolerance to the anesthetic than spring chinook salmon smolts. We speculate that increasing the anesthetic dosage may be desirable to reduce the stress effects of this operation on sockeye salmon. Obviously, more information is needed in this area.

Collection of Adults from Transportation Tests in 1984-85

There are few adult returns to report at this time (Table 5). So far, four sockeye salmon jacks from the 1984 test were trapped at Bonneville Dam. There was an exceptional run of sockeye salmon in 1985, and it is reasonable to expect that considerable numbers of tagged fish from the Priest Rapids Dam study were a part of that run.

At Bonneville Dam, trapping operations were hindered because little powerhouse generation (Second Powerhouse) occurred during the summer; hence, attraction for fish to enter the north ladder was reduced. At McNary Dam fewer fish than expected used the north ladder and likewise were not available to our trapping apparatus.

We believe that a CWT actuated trapping device is an absolute necessity at Priest Rapids Dam. Since nearly all upstream migrants pass through the east bank ladder, the recovery of tagged fish should be very efficient compared to current operations at Bonneville and McNary Dams.

It is interesting that eight chinook salmon (one fish and seven fish from the tests in 1984 and 1985, respectively) were recovered in the Oregon State University experimental fishery in Oregon coastal waters. The few other returns are listed in Appendix Tables 2 to 13.

Table 5.--Summary of returns of chinook and sockeye salmon from control and transport releases of smolts tagged in 1984 and 1985 at Priest Rapids Dam.

Year, species, release site, and experimental group	Number of smolts released	Number of adults recovered
1984 - Sockeye salmon		
Control - Priest Rapids	20,674	1
Transport - Bonneville	20,731	3
Chinook salmon		
Control - Priest Rapids	38,247	0
Transport - Bonneville	38,673	2
1985 - Sockeye salmon		
Control - Priest Rapids	55,432	0
Transport - Bonneville	55,406	0
Control - Priest Rapids[a/]	8,559	0
Transport - Bonneville[a/]	8,602	0
Chinook Salmon		
Control - Priest Rapids	49,700	3
Transport - Bonneville	50,490	5
Control - Priest Rapids[a/]	25,553	0
Transport - Bonneville[a/]	26,287	0

[a/] Smolts from these groups were collected at Wanapum Dam, transferred to Priest Rapids Dam, marked, and subsequently treated the same as those fish from Priest Rapids Dam.

A substantial number of tagged sockeye and chinook salmon may return to the Columbia River in 1986, thereby providing useful data for future analysis, if sufficient numbers are collected in the inriver traps or inriver and ocean fisheries.

SUMMARY AND CONCLUSIONS

1. During 1985, 101,190 spring chinook salmon and 110,838 sockeye salmon were marked from gatewell collection operations at Priest Rapids Dam. An additional 51,840 spring chinook salmon and 17,201 sockeye salmon were marked from gatewell collection at Wanapum Dam.

2. Seawater challenge tests indicated that chinook salmon were not significantly stressed during marking or transportation processes. Limited data indicated that sockeye salmon may be stressed during handling/marking. Only chinook salmon were targeted during seawater challenge tests.

3. As expected, the number of adults returning from smolt transportation studies at Priest Rapids Dam are low at this time. Only 4 sockeye and 10 chinook salmon have been recorded. By 1986, more returns are expected to provide the basis for analysis.

RECOMMENDATIONS

1. Experiments are required to determine the effects of increasing anesthetic concentrations during marking procedures. Stress to sockeye salmon may be reduced if concentrations are increased.

2. A CWT actuated trapping device is required at Priest Rapids Dam. This is necessary to recovery sufficient spring chinook and sockeye salmon for proper evaluation of the transportation experiments.

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Appendix Table 1.—Seawater challenge test data for spring chinook salmon sampled before and after handling/marking and after transport at Priest Rapids Dam, spring 1985. Data include test numbers, descaling, and average length of live and dead fish by sample area and replicate after a 24-h exposure to artificial seawater (includes data for steelhead and sockeye salmon which were unintentionally sampled with spring chinook salmon in some tests).

		Dead fish									Live fish								
		Number nondescaled			Number descaled			Average fork length (mm)			Number nondescaled			Number descaled			Average fork length (mm)		
Test	Date	SC[a]	ST	SO	SC	ST	SO	SC	ST	SO	SC	ST	SO	SC	ST	SO	SC	ST	SO
								Test Condition - Transfer Container - Pre-Mark											
1/1	08 May	0	0	0	0	0	0	-	-	-	36	0	2	0	0	0	130.5	-	91.0
1/2	08 May	1	0	0	0	0	0	116.0	-	-	25	2	4	0	0	0	130.0	173.5	100.0
1/3	08 May	2	0	0	0	0	0	120.0	-	-	25	0	7	0	0	0	135.9	-	90.4
2/1	11 May	12	1	0	0	0	0	123.1	205.0	-	34	2	15	1	0	0	130.0	210.0	94.0
2/2	11 May	1	0	0	0	0	0	125.0	-	-	32	0	18	1	1	0	129.7	210.0	87.8
2/3	11 May	8	0	0	1	0	0	109.1	-	-	36	2	1	1	0	0	130.9	200.0	85.0
2/4	11 May	5	0	0	0	0	0	123.2	-	-	47	3	0	0	1	0	132.7	208.5	-
3/1	15 May	4	0	0	1	0	0	119.8	-	-	16	0	2	0	0	0	131.9	-	107.5
3/2	15 May	4	0	1	0	0	0	130.0	-	82.0	19	1	3	0	0	0	132.4	165.0	88.3
3/3	15 May	9	0	0	1	0	0	118.7	-	-	22	0	9	0	0	0	132.5	-	105.2
3/4	15 May	6	0	0	1	0	0	119.6	-	-	15	0	2	1	0	0	129.3	-	85.0
Totals or averages		47	1	1	4	0	0	120.5	205.0	82.0	260	7	63	4	1	0	131.4	191.7	93.4

Appendix Table 1.--continued.

Test	Date	Dead fish: Number nondescaled SC	ST	SO	Number descaled SC	ST	SO	Average fork length (mm) SC	ST	SO	Live fish: Number nondescaled SC	ST	SO	Number descaled SC	ST	SO	Average fork length (mm) SC	ST	SO
								Test Condition - Pre-Transport											
1/1	08 May	1	0	0	0	0	0	100.0	-	-	38	0	12	1	0	0	129.3	-	92.3
1/2	08 May	0	0	0	0	0	0	-	-	-	19	0	6	0	0	0	120.1	-	92.7
1/3	08 May	4	0	0	0	0	0	113.8	-	-	29	0	17	0	0	1	121.8	-	89.3
2/1	11 May	2	0	2	0	0	0	109.5	-	70.0	33	0	17	0	0	0	128.4	-	92.3
2/2	11 May	2	0	2	0	0	0	120.0	-	81.5	21	0	23	0	0	0	131.4	-	87.9
2/3	11 May	8	0	0	0	0	0	110,3	-	-	37	0	11	1	0	0	126.5	-	84.8
2/4	11 May	1	0	1	0	0	0	122.0	-	66.0	19	0	11	0	0	0	128.5	-	87.3
3/1	15 May	6	0	0	0	0	0	118.3	-	-	16	0	4	0	0	0	128.2	-	88.8
3/2	15 May	13	0	0	0	0	0	125.4	-	-	29	0	0	1	0	0	132.1	-	-
3/3	15 May	8	0	3	0	0	0	117.0	-	80.0	11	0	8	0	0	0	126.6	-	90.6
3/4	15 May	14	0	11	0	0	0	120.3	-	83.1	31	0	15	0	0	0	133.6	-	96.3
Totals or averages		59	0	19	0	0	0	115.7		76.1	283	0	124	3	0	1	127.9		90.2

Appendix Table 1.—continued.

Test	Date	Dead fish: Number nondescaled SC[a]	ST	SO	Number descaled SC	ST	SO	Average fork length (mm) SC	ST	SO	Live fish: Number nondescaled SC	ST	SO	Number descaled SC	ST	SO	Average fork length (mm) SC	ST	SO
										Test Condition - Post-Transport									
1/1	08 May	1	0	2	0	0	0	120.0	-	81.5	18	0	44	1	0	0	129.0	-	90.4
1/2	08 May	1	0	4	0	0	0	114.0	-	76.8	18	0	15	0	0	0	138.9	-	91.8
1/3	08 May	1	0	2	0	0	0	137.0	-	89.0	22	0	6	0	0	0	135.8	-	88.7
2/1	11 May	5	0	18	0	0	0	122.0	-	84.1	24	0	42	0	0	0	129.5	-	82.9
2/2	11 May	6	0	29	0	0	0	115.0	-	85.0	31	0	40	0	0	0	131.5	-	89.0
2/3	11 May	12	0	29	0	0	0	116.6	-	82.9	27	0	16	0	0	0	130.1	-	86.9
2/4	11 May	2	0	48	0	0	0	131.0	-	84.2	27	0	40	0	0	0	126.1	-	90.3
3/1	15 May	0	0	1	1	0	1	130.0	-	82.0	14	0	18	0	0	1	135.9	-	90.1
3/2	15 May	1	0	4	1	0	0	122.5	-	84.3	16	0	16	1	0	1	136.9	-	89.8
3/3	15 May	9	0	5	0	0	0	123.6	-	84.8	25	0	17	2	0	0	128.7	-	96.6
3/4	15 May	4	0	3	1	0	0	135.2	-	85.0	38	0	12	1	0	1	132.7	-	91.8
Total or average		42	0	145	3	0	1	124.3		83.6	260	0	266	8	0	3	132.3		89.8

[a] SC = spring chinook, ST = steelhead, SO = sockeye.

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Appendix Table 2.-- 1984 GRANT CO. PUD - PRIEST RAPIDS/CONTROL

SOCKEYE

MARKS USED	LAIU1	LAIR1	LAIM1	LAIU3	231702	NUMBER RELEASED	22674
	231704	231706	231660	231654	231656		
	231656	231708					

RECOVERY AREA	1984	1985	TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0	1	1	0.004
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN FISHERIES	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
HATCHERIES	0	0	0	0.000
TOTALS	0	1	1	0.004
PERCENT OF RECOVERY	0.0	100.0		

Appendix Table 3.-- 1984 GRANT CO. PUD - PRIEST RAPIDS/TRANSPORT

SOCKEYE

MARKS USED	RAIC1 231705 231657	RAID1 231707 231659	RAIF1 231709	RAIC3 231653	231703 231655	NUMBER RELEASED	ENTIL

RECOVERY AREA	1984	1985	TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0	3	3	0.014
MONARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN FISHERIES	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
HATCHERIES	0	0	0	0.000
TOTALS	0	3	3	0.014
PERCENT OF RECOVERY	0.0	100.0		

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Appendix Table 4.-- 1984 GRANT CO. PUD – PRIEST RAPIDS/CONTROL

SPRING/SUMMER CHINOOK

MARKS USED	LAIU1	LAIR1	LAIM1	LAIU3	231702	NUMBER RELEASED	38047
	231704	231706	231660	231654	231656		
	231658	231708					

RECOVERY AREA	1984	1985	TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0	0	0	0.000
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN FISHERIES	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
HATCHERIES	0	0	0	0.000
TOTALS	0	0	0	0.000
PERCENT OF RECOVERY	0.0	0.0		

Appendix Table 5.-- 1984 GRANT CO. PUD - PRIEST RAPIDS/TRANSPORT

SPRING/SUMMER CHINOOK

MARKS USED					NUMBER RELEASED
RAIC1	RAID1	RAIF1	RAIC3	231703	35873
231705	231707	231709	231653	231655	
231657	231659				

RECOVERY AREA	1984	1985	TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0	1	1	0.002
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN FISHERIES				
OREGON	0	1	1	0.002
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
HATCHERIES	0	0	0	0.000
TOTALS	0	2	2	0.005
PERCENT OF RECOVERY	0.0	100.0		

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Appendix Table 6.-- 1985 GRANT CO. PUD - PRIEST RAPIDS/TRANSPORT

SOCKEYE

MARKS USED						NUMBER RELEASED	55402
	RAIH1	RAIJ1	RAIF1	RAIH3	RAIJ3		
	RAIK1	RAIK3	231746	231710	231712		
	231714	231748	231756	231716	231750		
	231752	231754	231726	231757			

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		

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Appendix Table 7.-- 1985 GRANT CO. PUD - PRIEST RAPIDS/TRANSPORT

SOCKEYE

MARKS USED						NUMBER RELEASED	55405
	RAIH1	RAIJ1	RAIF1	RAIH3	RAIJ3		
	RAIK1	RAIK3	231746	231710	231712		
	231714	231748	231756	231716	231750		
	231752	231754	231726	231757			

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		

Appendix Table 8.-- 1985 GRANT CO. PUD - PRIEST RAPIDS/CONTROL

SPRING/SUMMER CHINOOK

MARKS USED					NUMBER RELEASED	
RAIL1	RAIN1	RAIS1	RAIL3	RAIN3		49702
RAIS3	231753	231711	231713	231715		
231755	231758	231717	231747	231749		
231751	231719	231759				

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES				
OREGON	3		3	0.006
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	3		3	0.006
PERCENT OF RECOVERY	100.0	100.0		

Appendix Table 9.-- 1985 GRANT CO. PUD — PRIEST RAPIDS/TRANSPORT

SPRING/SUMMER CHINOOK

MARKS USED	RAIH1	RAIJ1	RAIF1	RAIH3	RAIJ3	NUMBER RELEASED	52490
	RAIK1	RAIK3	231746	231710	231712		
	231714	231748	231756	231716	231750		
	231752	231754	231726	231757			

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	1		1	0.021
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES				
OREGON	4		4	0.007
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	5		5	0.009
PERCENT OF RECOVERY	100.0	100.0		

Appendix Table 10.-- 1985 GRANT CO. PUD - WANAPUM/TRANSPORT

SOCKEYE

MARKS USED	RAIZ1	RAIY1	RAIX1	RAIZ3	RAIY3	NUMBER RELEASED	8622
	231728	231730	231740	231722	231744		
	231662	231718	231720	231742	231724		

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		2	0.023
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		

Appendix Table 11.-- 1985 GRANT CO. PUD - WANAPUM/CONTROL

SOCKEYE

MARKS USED	RA2C1	RA2J1	RA141	RA2C3	RA2J3	NUMBER RELEASED	6559
	231725	231727	231741	231743	231745		
	231661	231663	231701	231721	231723		

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		

Appendix Table 12.-- 1985 GRANT CO. PUD - WANAPUM/CONTROL

SPRING/SUMMER CHINOOK

MARKS USED	RA2C1	RA2J1	RA141	RA2C3	RA2J3	NUMBER RELEASED	25553
	231725	231727	231741	231743	231745		
	231661	231663	231701	231721	231723		

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		

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Appendix Table 13.-- 1985 GRANT CO. PUD - WANAPUM/TRANSPORT

SPRING/SUMMER CHINOOK

MARKS USED	RAIZ1	RAIY1	RAIX1	RAIZ3	RAIY3	NUMBER RELEASED	25237
	231728	231730	231740	231722	231744		
	231662	231718	231720	231742	231724		

RECOVERY AREA	1985		TOTALS	PERCENT RETURN
RIVER SYSTEM TRAPS				
BONNEVILLE TRAP	0		0	0.000
MCNARY TRAP	0		0	0.000
LOWER GRANITE TRAP	0		0	0.000
OCEAN FISHERIES	0		0	0.000
RIVER SPORT	0		0	0.000
RIVER COMMERCIAL	0		0	0.000
INDIAN FISHERY	0		0	0.000
HATCHERIES	0		0	0.000
TOTALS	0		0	0.000
PERCENT OF RECOVERY	0.0	0.0		